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AUTONOMY YOU CAN TRUST

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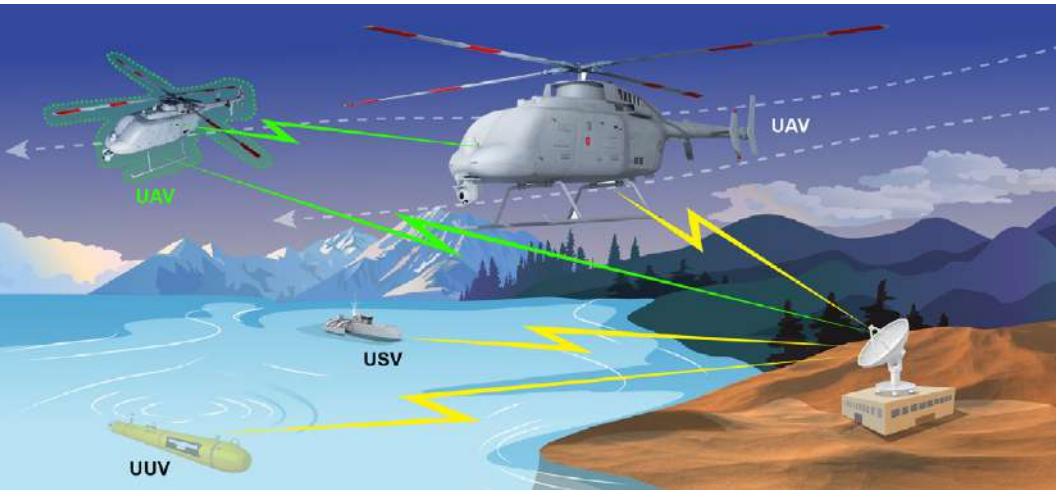
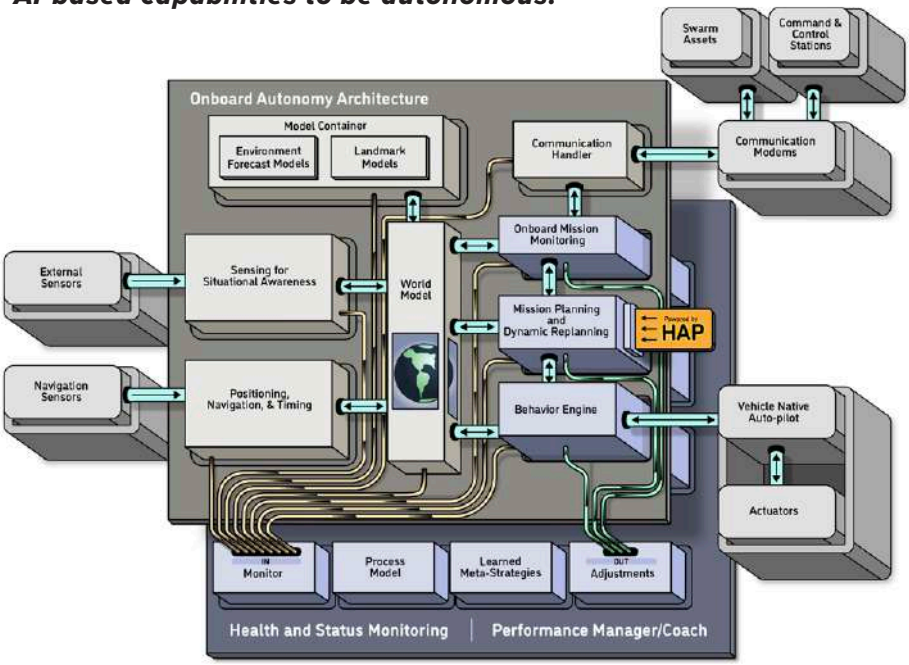
Wondering how to make autonomy work in complex, unpredictable operational environments with intermittent, limited, or nonexistent bandwidth? How to move your autonomous operations from human *in*-the-loop to human *on*-the-loop control? How to negotiate skyrocketing technical complexity when moving from a single vehicle to a heterogeneous swarm, which can act and reason in ways that defy intuition?

For autonomous systems, there are a multitude of interrelated problems and no grand unified theory that solves them all. So we've built our expertise from the ground up, developing proof-of-concept demonstrations, highly capable prototypes, and innovative products for a wide range of autonomous applications, supported along the way by an engaged user community and distinguished sponsors through countless government technology development programs. We integrate this diverse work into a unified autonomy framework and architecture, guided by a surprisingly simple idea:

True autonomy will be widely adopted only when it can *earn your trust.*



A single unmanned asset requires many complex AI-based capabilities to be autonomous.



Sensing for Situational Awareness

- Detect, classify, localize, and track objects or environmental processes
- Collect geo-registered data in an unknown environment
- Inform the World Model for use in mission planning/re-planning

Command & Control Stations

- Share data and decisions with C2 stations and other collaborating unmanned systems

Positioning, Navigation, and Timing

- Estimate the position and orientation of the vehicle in a global coordinate frame
- Navigate in unexplored environments under different environmental conditions

Onboard Mission Monitoring

- Collect dynamic progress against mission objectives, and trigger re-planning based on priority mission goals as necessary

Health and Status Monitoring

- Monitor vehicle subsystem performance to identify failures that influence mission capability
- Trigger replanning to mitigate failures, "fight through", or abort mission as necessary

Mission Planning and Dynamic Replanning

- Select and execute the best mission plan for the situation to achieve mission goals
- Adapt mission parameters to the environment and platform

Communication Handler

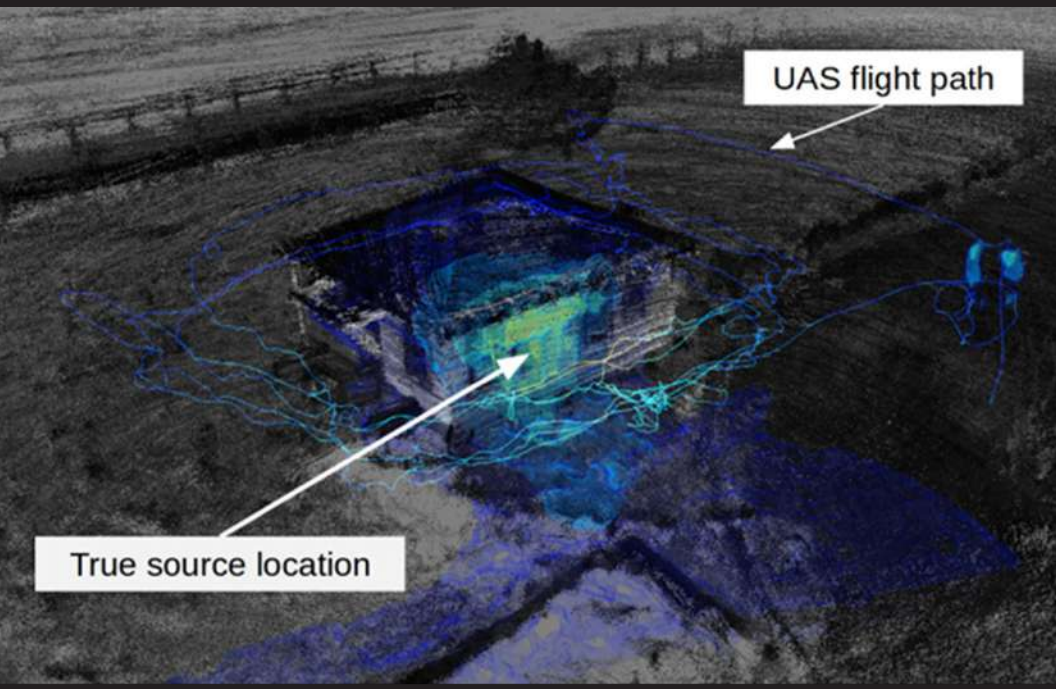
- Manage multiple comms paths and dynamically manage paths as a function of data priority, available bandwidth, and network states

Behavior Engine

- Implement dynamic mission plans by activating collections of autonomous behaviors that appropriately manage conflicting goals

EXPANDING AUTONOMOUS SENSING CAPABILITIES

To enable small autonomous or semi-autonomous drones to identify chemical, biological, radiological, and nuclear (CBRN) threats, MIDNIGHT applies advanced techniques from computer vision, machine learning, and autonomous navigation to the fields of radiation detection and perceptual sensing.



3-D LiDAR model with radiation source in bright blue (Pavlovsky et al. 2018)

PIONEERING RESILIENCE IN AUTONOMY SOFTWARE

Under DARPA's BRASS program, PRINCESS incorporates new advances in machine learning and probabilistic modeling to help build software systems that can understand, learn, and adapt to change. We grounded our research in unmanned underwater vehicle (UUV) platforms, which must quickly acclimate to changing environments, system failures, and new missions.

A REMUS 600 autonomous underwater vehicle (U.S. Navy photo by John F. Williams/ Released). PRINCESS applies machine learning and probabilistic programming to help UUV software adapt to ever-changing ecosystems.

ENABLING "SMART" AUTONOMOUS COMMUNICATIONS

To broaden the range of potential missions for UxVs, we are developing software tools that provide adaptive signaling behavior, such as choosing among alternative communications pathways to maximize the value and timeliness of information transmission based on mission relevance, operating situation, and bandwidth constraints.

ENHANCING AUTONOMOUS NAVIGATION

CAMINO is a system we developed for the US Navy to improve the accuracy of underwater positioning and navigation at a reduced size, weight, power, and cost (SWAP-C), enabling effective navigation for smaller, cheaper, and even expendable underwater assets.

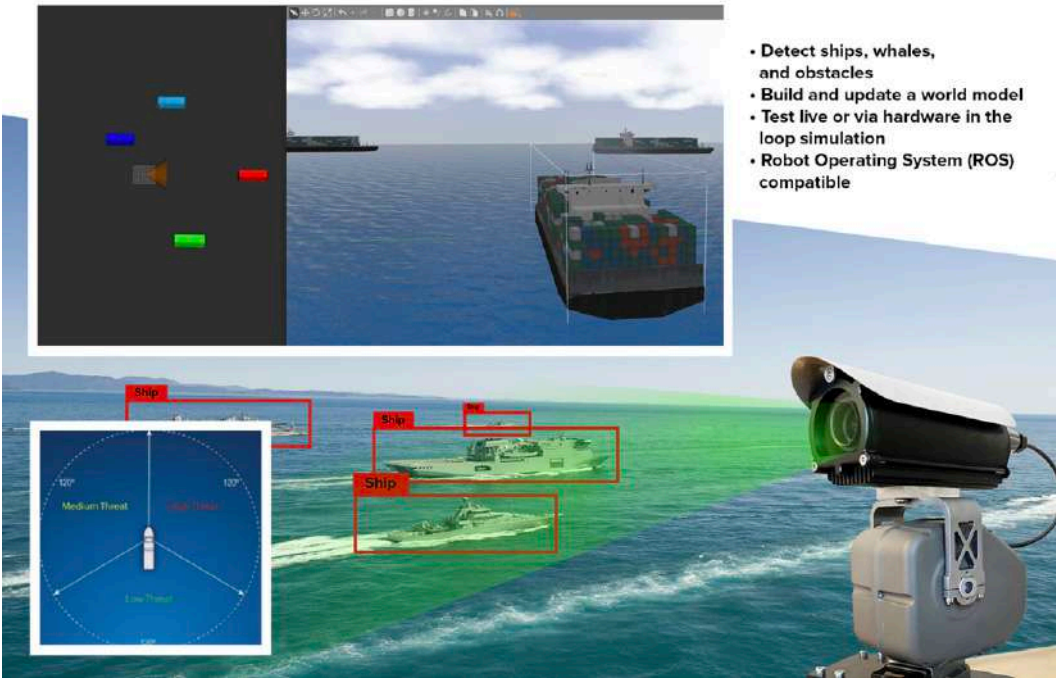
SENSING FOR SITUATIONAL AWARENESS

AWARION™
Autonomous Lookout System

Awarion™ Autonomous Lookout System

Awarion is a developing integrated software and hardware smart camera system that will deliver situational awareness at the sea surface—detecting and classifying ships, obstacles, and other objects, performing passive ranging, and tracking targets over time and across different sensors.

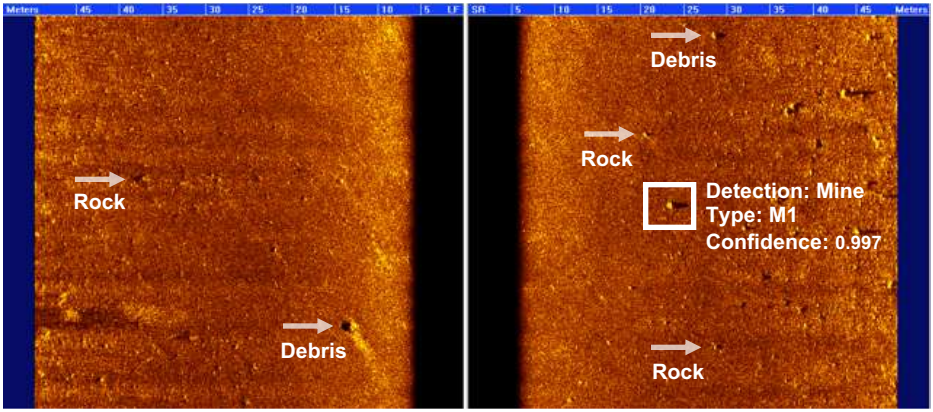
A ruggedized processing unit will offer autonomous pan-tilt-zoom capabilities to detect everything from navigational aids to marine mammals, providing an important sensing solution for autonomous vehicles.



AutoTRap ONBOARD™

AutoTRap Onboard™

We recently released AutoTRap Onboard™, our AI-based object detection software that analyzes side scan sonar data, generating contact reports in real time, instead of in post-mission analysis. AutoTRap Onboard readily integrates onto the market-leading Teledyne Gavia line of autonomous underwater vehicles (AUVs), expanding their already impressive survey capabilities.



When objects are detected, AutoTRap Onboard provides contact alerts to your system.

TEAMING WITH AUTONOMOUS SWARMS

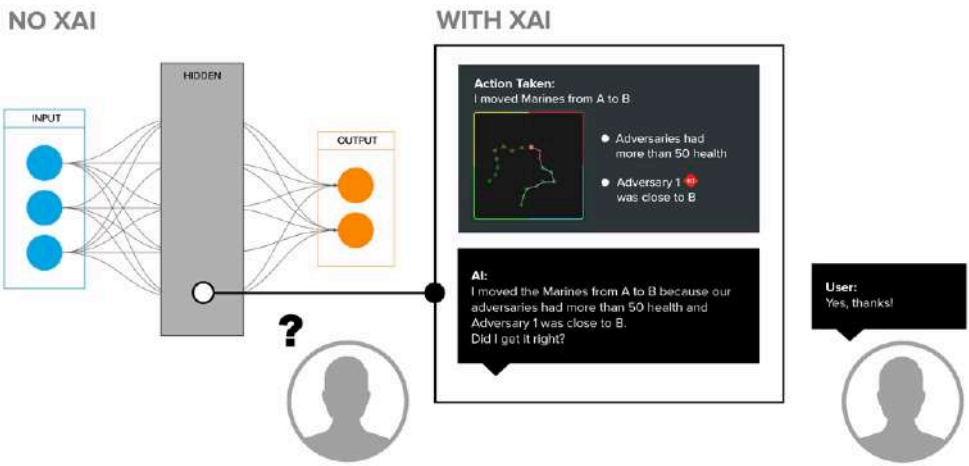
In support of the US Army's Combat Vehicle Robotics (CoVeR) program, MANTA enables robust, natural, heads-up and hands-free direction of autonomous behaviors for multiple unmanned systems in complex environments.

Under DARPA's OFFensive Swarm-Enabled Tactics (OFFSET) program, we developed EUROPA, which provides novel, tactically tailored, multimodal user interfaces to help operators control drone swarms.

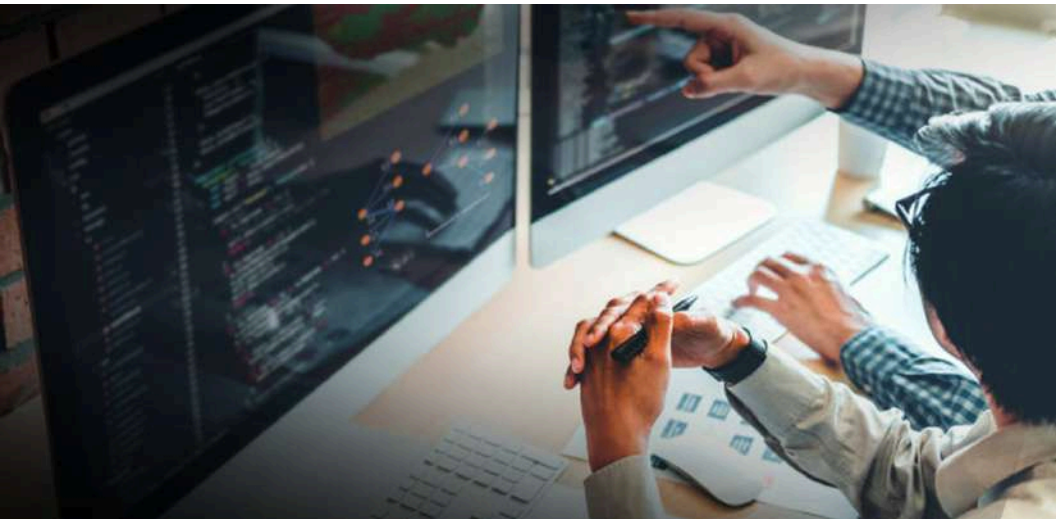
With SATURN, we developed capabilities that give heterogeneous swarms of unlimited size resilient behavior while achieving mission objectives.

Our MERLIN effort applies a meta-reinforcement learning approach to discover and learn novel swarm tactics.

MAKING AI UNDERSTANDABLE
THE ULTIMATE BASIS FOR TRUST



Under DARPA's Explainable Artificial Intelligence (XAI) effort, our team developed probabilistic causal modeling techniques and an explanatory interface that enables users to naturally understand and interact with machines. CAMEL creates simple, understandable explanations of how these complex, deep learning machines work, the key to helping human operators develop trust in autonomy.



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Charles River Analytics specializes in using leading-edge R&D to solve our clients' toughest, most complex problems. Our wide range of robotic subsystems and autonomy components are designed to seamlessly integrate with current and evolving platforms.

Our deep understanding of applied robotics and autonomous systems is the result of extensive research, development, and deployment across many disciplines, such as AI, machine learning, cognitive science, and human factors. This understanding uniquely positions us to provide mature solutions tailored to our customers' needs.

By integrating our reliable, adaptable robotic subsystems with existing solutions, our customers and their end users can achieve mission-level autonomy for single and multiplatform systems.

Employee-Owned
Small Business

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